

REMARKS

CONTINUED EXAMINATION UNDER 37 CFR 1.114

The Applicant notes that the Request for Continued Examination filed on 11/13/2002 is entered; however, the Examiner should note that claims 1-18 were canceled in the Request and claims 19-43 were added. Therefore, any reference to claims 1-18 in the Office Action is considered moot by the Request for Continued Examination.

CLAIM REJECTIONS

Claims 1-18 were canceled in the Request for Continued Examination filed on 11/13/2002, therefore, the Claim Rejections related to claims 12-15 referred to in this section are rendered moot.

Claim 28 is herein amended to replace references to titanium with tantalum.

35 USC §102(E)

Claims 1, 12, 16-19 and 29-33 are rejected under 35 USC §102(e) as being anticipated by Kaufman (US 5,954,997). The Applicant respectfully disagrees. Claims 1, 12 and 16-18 were canceled in the Request for Continued Examination filed on November 13, 2002.

Claim 19 recites:

A method of accomplishing chemical mechanical planarization of a Cu/Ta/TaN surface comprising:

providing a single-step slurry solution including a combination selected from the group consisting of (i) H₂O₂ with H₃PO₄, H₂SO₄, HNO₃, oxalic acid, acetic acid, or organic acid, (ii) HNO₃ with H₃PO₄, or H₂SO₄; and (iii) an oxidizing reagent with HF;

applying the solution to the surface; and

planarizing both the Cu and at least one of the Ta and TaN during a single processing step.

The Kaufman reference still does not solve the problem that the present application addresses. Kaufman ('997) states that the disclosed slurries can polish layers containing copper or copper alloys. The Detailed Description in Column 9 under the "Examples" section states that the copper alloys that are effectively polished are copper and titanium/titanium nitride alloys. If you take this reference and then read the other Kaufman reference cited in this prosecution (6,063,306) it becomes very clear that it is extremely difficult to remove copper alloys that contain tantalum by using a single slurry. (see Column 3 of that reference). Although the '997 reference states that they have found "acceptable" etching rates for tantalum and tantalum nitride - there is absolutely no indication that there is a high Cu:Ta selectivity - especially when considering the ('306) reference in

the same context - which clearly states that high Cu:Ta selectivity cannot be achieved with a single-step slurry.

Kaufman does not teach the claimed elements of the present application. “Anticipation requires the disclosure in a single prior art reference of each element of the claim under consideration.” *W. L. Gore & Assocs. v. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303, 313 (Fed. Cir. 1983) (citing *Soundsciber Corp. v. United States*, 360 F.2d 954, 148 USPQ 298, 301 (Ct. Cl.), *adopted*, 149 USPQ 640 (Ct. Cl. 1966)) Further, the prior art reference must disclose each element of the claimed invention “**arranged as in the claim**”. *Lindermann Maschinenfabrik GmbH v. American Hoist & Derrick Co.*, 730 F.2d 1452, 221 USPQ 481, 485 (Fed. Cir. 1984)(citing *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 220 USPQ 193 (Fed. Cir. 1983)). Kaufman does not teach providing a single-step slurry solution that has a high Cu:Ta selectivity (not just “acceptable”) including a combination selected from the group consisting of (i) H₂O₂ with H₃PO₄, H₂SO₄, HNO₃, oxalic acid, acetic acid, or organic acid, (ii) HNO₃ with H₃PO₄, or H₂SO₄; and (iii) an oxidizing reagent with HF. Based on this argument, along with others such as that discussed above, Kaufman does not anticipate claim 19 of the present application because Kaufman is lacking and/or missing at least one specific feature or structural recitation found in the present application, and in claim 19. Claim 19 is therefore allowable as not being anticipated by Kaufman. Further, Kaufman does not anticipate claims 29-33 of the present application by virtue of their dependency on claim 19.

35 USC §103(A)

Claims 13-15 are rejected under 35 USC §103(a) as being unpatentable over Kaufman et al (US 5,954,997) in view of Hampden-Smith et al. (US 6,602,439). The Applicant respectfully disagrees, especially considering the fact that claims 13-15 were canceled as part of the Request for Continued Examination filed on November 13, 2002.

Claims 1, 12, 16-23, 28-35 and 39-43 are rejected under 35 USC §103(a) as being unpatentable over Kaufman et al (US 5,954,997) in view of Applicants Admitted Prior Art (Admission). The Applicant respectfully disagrees. Claims 1, 12 and 16-18 were canceled as part of the Request for Continued Examination filed on November 13, 2002.

Claim 19 recites:

A method of accomplishing chemical mechanical planarization of a Cu/Ta/TaN surface comprising:

providing a single-step slurry solution including a combination selected from the group consisting of (i) H₂O₂ with H₃PO₄, H₂SO₄, HNO₃, oxalic acid, acetic acid, or organic acid, (ii) HNO₃ with H₃PO₄, or H₂SO₄; and (iii) an oxidizing reagent with HF;

applying the solution to the surface; and

planarizing both the Cu and at least one of the Ta and TaN during a single processing step.

Claim 34 recites:

“A reagent mixture for polishing a surface comprising at least one metal having a high rate of diffusion and at least one barrier layer that is mechanically hard, the mixture comprising:

- a) an oxidizing reactant selected from the group consisting of H_2O_2 , HNO_3 and mixtures thereof; and
- b) a co-reactant is selected from the group consisting of H_3PO_4 , H_2SO_4 , HNO_3 , oxalic acid, acetic acid, organic acids and mixtures thereof,

wherein the reagent mixture achieves about a 1:1 removal selectivity between the at least one metal and the at least one barrier layer.” (emphasis added)

The Kaufman reference still does not solve the problem that the present application addresses. Kaufman ('997) states that the disclosed slurries can polish layers containing copper or copper alloys. The Detailed Description in Column 9 under the “Examples” section states that the copper alloys that are effectively polished are copper and titanium/titanium nitride alloys. If you take this reference and then read the other Kaufman reference cited in this prosecution (6,063,306) it becomes very clear that it is extremely difficult to remove copper alloys that contain tantalum by using a single slurry. (see Column 3 of that reference). Although the '997 reference states that they have found “acceptable” etching rates for tantalum and tantalum nitride - there is absolutely no indication that there is a high Cu:Ta selectivity - especially when considering the ('306) reference in the same context - which clearly states that high Cu:Ta selectivity cannot be achieved with a single-step slurry. Therefore, the Applicants respectfully request the Examiner to consider the full spectrum of the art when reviewing the subject matter of this application and reconsider this rejection. At the time this application was filed, I do not believe that one of ordinary skill in the art could take the

Kaufman references and consider that the Kaufman slurries would be effective at achieving a high Cu:Ta selectivity. Therefore, one of ordinary skill in the art would not consider the Kaufman references to teach, suggest or motivate one of ordinary skill in the art to use those slurries to achieve a high Cu:Ta selectivity in polishing. In addition, the Applicants Admitted Prior Art does not correct this deficiency. Thus, claims 19 and 34 are allowable as not being obvious in view of the cited art, and in addition, the related dependent claims are also allowable as not being obvious in view of the cited art.

Claims 36-38 are rejected under 35 USC §103(a) as being unpatentable over Kaufman et al (US 5,954,997) in view of Applicants Admitted Prior Art (Admission) as applied to claims 1, 12, 16-23, 27, 28-35 and 39-43 and in further view of Hampden-Smith et al. The Applicant respectfully disagrees. Claims 1, 12 and 16-18 were canceled as part of the Request for Continued Examination filed on November 13, 2002.

Claim 19 recites:

A method of accomplishing chemical mechanical planarization of a Cu/Ta/TaN surface comprising:

providing a single-step slurry solution including a combination selected from the group consisting of (i) H₂O₂ with H₃PO₄, H₂SO₄, HNO₃, oxalic acid, acetic acid, or organic acid, (ii) HNO₃ with H₃PO₄, or H₂SO₄; and (iii) an oxidizing reagent with HF;

applying the solution to the surface; and

planarizing both the Cu and at least one of the Ta and TaN during a single processing step.

Claim 34 recites:

“A reagent mixture for polishing a surface comprising at least one metal having a high rate of diffusion and at least one barrier layer that is mechanically hard, the mixture comprising:

- a) an oxidizing reactant selected from the group consisting of H_2O_2 , HNO_3 and mixtures thereof; and
- b) a co-reactant is selected from the group consisting of H_3PO_4 , H_2SO_4 , HNO_3 , oxalic acid, acetic acid, organic acids and mixtures thereof,

wherein the reagent mixture achieves about a 1:1 removal selectivity between the at least one metal and the at least one barrier layer.” (emphasis added)

The Kaufman reference still does not solve the problem that the present application addresses. Kaufman ('997) states that the disclosed slurries can polish layers containing copper or copper alloys. The Detailed Description in Column 9 under the “Examples” section states that the copper alloys that are effectively polished are copper and titanium/titanium nitride alloys. If you take this reference and then read the other Kaufman reference cited in this prosecution (6,063,306) it becomes very clear that it is extremely difficult to remove copper alloys that contain tantalum by using a single slurry. (see Column 3 of that reference). Although the '997 reference states that they have found “acceptable” etching rates for tantalum and tantalum nitride - there is absolutely no indication that there is a high Cu:Ta selectivity - especially when considering the ('306) reference in the same context - which clearly states that high Cu:Ta selectivity cannot be achieved with a single-step slurry. Therefore, the Applicants respectfully request the Examiner to consider the full spectrum of the art when reviewing the subject matter of this application and reconsider this rejection. At the time this application was filed, I do not believe that one of ordinary skill in the art could take the Kaufman references and consider that the Kaufman slurries would be effective at achieving a high Cu:Ta selectivity. Therefore, one of ordinary skill in the art would not consider the Kaufman references to teach, suggest or motivate one of ordinary skill in the art to use those slurries to achieve

a high Cu:Ta selectivity in polishing. In addition, Hampden-Smith and the Applicants Admitted Prior Art do not correct this deficiency. Thus, claims 19 and 34 are allowable as not being obvious in view of the cited art, and in addition, the related dependent claims are also allowable as not being obvious in view of the cited art.

Claim 24 is rejected under 35 USC §103(a) as being unpatentable over Kaufman et al (US 5,954,997) or Kaufman et al (US 5,954,997) in view of Applicants Admitted Prior Art (Admission) as applied to claim 19 and in further view of Pozniak or Avanzino. The Applicant respectfully disagrees. First, the Applicant respectfully requests clarification on the rejection. Is the 103 rejection over Kaufman ('997) alone and Kaufman ('997) in combination with other references, or is this a mistake in the Examiner's text?

Claim 19 recites:

A method of accomplishing chemical mechanical planarization of a Cu/Ta/TaN surface comprising:

providing a single-step slurry solution including a combination selected from the group consisting of (i) H_2O_2 with H_3PO_4 , H_2SO_4 , HNO_3 , oxalic acid, acetic acid, or organic acid, (ii) HNO_3 with H_3PO_4 , or H_2SO_4 ; and (iii) an oxidizing reagent with HF;

applying the solution to the surface; and

planarizing both the Cu and at least one of the Ta and TaN during a single processing step.

The Kaufman reference still does not solve the problem that the present application addresses. Kaufman ('997) states that the disclosed slurries can polish layers containing copper or

copper alloys. The Detailed Description in Column 9 under the “Examples” section states that the copper alloys that are effectively polished are copper and titanium/titanium nitride alloys. If you take this reference and then read the other Kaufman reference cited in this prosecution (6,063,306) it becomes very clear that it is extremely difficult to remove copper alloys that contain tantalum by using a single slurry. (see Column 3 of that reference). Although the ‘997 reference states that they have found “acceptable” etching rates for tantalum and tantalum nitride - there is absolutely no indication that there is a high Cu:Ta selectivity - especially when considering the (‘306) reference in the same context - which clearly states that high Cu:Ta selectivity cannot be achieved with a single-step slurry. Therefore, the Applicants respectfully request the Examiner to consider the full spectrum of the art when reviewing the subject matter of this application and reconsider this rejection. At the time this application was filed, I do not believe that one of ordinary skill in the art could take the Kaufman references and consider that the Kaufman slurries would be effective at achieving a high Cu:Ta selectivity. Therefore, one of ordinary skill in the art would not consider the Kaufman references to teach, suggest or motivate one of ordinary skill in the art to use those slurries to achieve a high Cu:Ta selectivity in polishing. In addition, Pozniak, Avanzino and the Applicants Admitted Prior Art do not correct this deficiency. Thus, claim 19 is allowable as not being obvious in view of the cited art, and in addition, the related dependent claims are also allowable as not being obvious in view of the cited art.

Claim 25 is rejected under 35 USC §103(a) as being unpatentable over Kaufman et al (US 5,954,997) or Kaufman et al (US 5,954,997) in view of Applicants Admitted Prior Art (Admission) as applied to claim 19 and in further view of Cronin et al. or Carpio. The Applicant respectfully disagrees. First, the Applicant respectfully requests clarification on the rejection. Is the 103 rejection over Kaufman (‘997) alone and Kaufman (‘997) in combination with other references, or is this a mistake in the Examiner’s text?

Claim 19 recites:

A method of accomplishing chemical mechanical planarization of a Cu/Ta/TaN surface comprising:

providing a single-step slurry solution including a combination selected from the group consisting of (i) H_2O_2 with H_3PO_4 , H_2SO_4 , HNO_3 , oxalic acid, acetic acid, or organic acid, (ii) HNO_3 with H_3PO_4 , or H_2SO_4 ; and (iii) an oxidizing reagent with HF;

applying the solution to the surface; and

planarizing both the Cu and at least one of the Ta and TaN during a single processing step.

The Kaufman reference still does not solve the problem that the present application addresses. Kaufman ('997) states that the disclosed slurries can polish layers containing copper or copper alloys. The Detailed Description in Column 9 under the "Examples" section states that the copper alloys that are effectively polished are copper and titanium/titanium nitride alloys. If you take this reference and then read the other Kaufman reference cited in this prosecution (6,063,306) it becomes very clear that it is extremely difficult to remove copper alloys that contain tantalum by using a single slurry. (see Column 3 of that reference). Although the '997 reference states that they have found "acceptable" etching rates for tantalum and tantalum nitride - there is absolutely no indication that there is a high Cu:Ta selectivity - especially when considering the ('306) reference in the same context - which clearly states that high Cu:Ta selectivity cannot be achieved with a single-step slurry. Therefore, the Applicants respectfully request the Examiner to consider the full spectrum of the art when reviewing the subject matter of this application and reconsider this rejection. At the time this application was filed, I do not believe that one of ordinary skill in the art could take the Kaufman references and consider that the Kaufman slurries would be effective at achieving a high Cu:Ta selectivity. Therefore, one of ordinary skill in the art would not consider the Kaufman references to teach, suggest or motivate one of ordinary skill in the art to use those slurries to achieve a high Cu:Ta selectivity in polishing. In addition, Cronin, Carpio and the Applicants Admitted Prior Art do not correct this deficiency. Thus, claim 19 is allowable as not being obvious in view of the

cited art, and in addition, the related dependent claims are also allowable as not being obvious in view of the cited art.

Claim 26 is rejected under 35 USC §103(a) as being unpatentable over Kaufman et al (US 5,954,997) or Kaufman et al (US 5,954,997) in view of Applicants Admitted Prior Art (Admission) as applied to claim 19 and in further view of Ohmori et al. The Applicant respectfully disagrees. First, the Applicant respectfully requests clarification on the rejection. Is the 103 rejection over Kaufman ('997) alone and Kaufman ('997) in combination with other references, or is this a mistake in the Examiner's text?

Claim 19 recites:

A method of accomplishing chemical mechanical planarization of a Cu/Ta/TaN surface comprising:

providing a single-step slurry solution including a combination selected from the group consisting of (i) H₂O₂ with H₃PO₄, H₂SO₄, HNO₃, oxalic acid, acetic acid, or organic acid, (ii) HNO₃ with H₃PO₄, or H₂SO₄; and (iii) an oxidizing reagent with HF;

applying the solution to the surface; and

planarizing both the Cu and at least one of the Ta and TaN during a single processing step.

The Kaufman reference still does not solve the problem that the present application addresses. Kaufman ('997) states that the disclosed slurries can polish layers containing copper or copper alloys. The Detailed Description in Column 9 under the "Examples" section states that the copper alloys that are effectively polished are copper and titanium/titanium nitride alloys. If you take this reference and then read the other Kaufman reference cited in this prosecution (6,063,306) it

becomes very clear that it is extremely difficult to remove copper alloys that contain tantalum by using a single slurry. (see Column 3 of that reference). Although the '997 reference states that they have found "acceptable" etching rates for tantalum and tantalum nitride - there is absolutely no indication that there is a high Cu:Ta selectivity - especially when considering the ('306) reference in the same context - which clearly states that high Cu:Ta selectivity cannot be achieved with a single-step slurry. Therefore, the Applicants respectfully request the Examiner to consider the full spectrum of the art when reviewing the subject matter of this application and reconsider this rejection. At the time this application was filed, I do not believe that one of ordinary skill in the art could take the Kaufman references and consider that the Kaufman slurries would be effective at achieving a high Cu:Ta selectivity. Therefore, one of ordinary skill in the art would not consider the Kaufman references to teach, suggest or motivate one of ordinary skill in the art to use those slurries to achieve a high Cu:Ta selectivity in polishing. In addition, Ohmori et al. and the Applicants Admitted Prior Art do not correct this deficiency. Thus, claim 19 is allowable as not being obvious in view of the cited art, and in addition, the related dependent claims are also allowable as not being obvious in view of the cited art.

REQUEST FOR AN EXAMINER'S INTERVIEW

The undersigned Attorney-of-Record respectfully requests an Examiner's Interview, if the above-referenced points are still at issue in this matter, in order to resolve any remaining issues before preparation of additional Papers in this matter.

REQUEST FOR ALLOWANCE

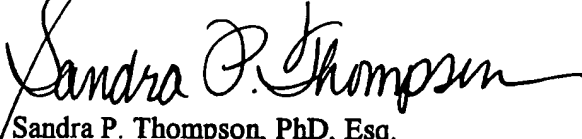
Claims 19-43 are pending in this application. The applicant requests allowance of all pending claims.

Respectfully submitted,

Bingham McCutchen, LLP

Dated: March 17, 2005

By:



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